## An Analysis of Avista Water Rights

Legal Aspects of Avista's Water Rights

In a decree issued August 27, 1986, Montana Water Judge Holter confirmed the 1951 and 1959 Avista water rights. Avista obtained the 1974 rights through the Montanan Water Use Act water right permitting process and the associated public notice and administrative review. Judge Holter's 1986 decree is subject to an additional objection period before issuance of a final decree by the Montana Water Court. About 30% of the water rights in the basin, by number, are junior to Avista's 1974 rights.

(Note regarding the Holter decree:
The author hasn't been able to find the testimony or other documentation of Judge Holter's decree from on-line sources. I am certain that the DNRC has records of this decision, but time constraints prevented me from investigating this decree further.)

Since the TRL decision in December of 2006 and, presumably, reinforced by Judge Holter's earlier confirmation, Avista's water rights have been treated as almost sacrosanct – beyond questioning, wholly complete and correct. Virtually no one, including the directorship of the DNRC Water Rights Bureau, is willing to question the accuracy or validity of Avista' water rights. Note Regarding the 50,000 cfs Avista Flow Rate: Every reference I have seen to Avista's right to 50,000 cfs from the Clark Fork River has been affirmative and unquestioning in its nature. What puzzles the author is what became of the 5,400 cfs flow rate in 76N 211889? It is like it simply doesn't exist. Unless my addition is incorrect, Avista's combined flow rate should be 55,400 cfs.

The lone exception to this overwhelmingly large capitulation to Avista's right has been an analysis prepared by Montana State Representative Verdell Jackson. In Appendix 4 to the Clark Fork River Basin Management Plan, *"Clark Fork River Flows Over Various Averaging Periods" (See Appendix N, Item 5, Pages 6 & 7, this report)*, Representative Jackson has this to say about the validity of Avista's water rights:

> *"There are many characteristics of Avista's water right that indicate that the water right was crafted to enable Avista to maximize its use of the maximum rate and volume that would be available in the Clark Fork River.*
>
> *Avista's water rights*
> *1951: Rate: 35,000 cfs, Volume 25,338,843 acre-feet per year*
> *1959: Rate: 5,400 cfs, Volume 3,909,421 acre-feet per year*
> *1974: Rate rose to 50,000 cfs* (Author's Note: the 1974 right is for an additional 15,000 cfs, which would make the total 55,400 cfs)
>
> *Over a period of years (1951 to 1974), Avista continued to request more water from DNRC until the total reached 50,000 cfs* (see Author's Note, above). *This rate is 2.5 times the average rate of flow of the Clark Fork River (20,000 cfs). Likewise, the water right for volume is 29 million acre-feet per year, which has never been available. The average yearly flow of the Clark Fork River is 14 million acre-feet, and the largest amount on record is about 20 million acre-feet. Avista likely analyzed peak flow data to compute the cost of additional generation capacity against revenue from water it was spilling and sized its facility and water rights accordingly. The amount of water that Avista is now spilling, although significant, most likely is not worth the extra cost of more generation capacity.*
>
> *Each request for additional rate and volume of water was approved without specifying the period of time when the rate was available. Since there is no detail in the water right certificate protecting water rights senior to Avista's water rights or future use of water for commercial or residential development in the Clark Fork basin, the possibility of a water call on junior users by Avista probably was not on the radar screen. Judge Holter in 1986 clarified the magnitude of the water rights and stated that "WWP continued to beneficially use all of the water that it appropriated to the extent that such water has been available in the Clark Fork River." He did not mention the fact that the 50,000 cfs was only available a few days a year and sometimes not at all or that the stated volume has never been available. Also, no mention was made regarding the possibility of a water call on junior water users as a result of the overstatement of volume and rate. Had this possibility been considered, language would certainly have been added to make sure that the interest of citizens of Montana would have been protected. Since Avista was not required to prove that the water was legally and physically available to meet it huge water right requests and no restrictive language was placed on Avista's water rights, does this mean that it is too late to correct this oversight? I think not, the final decree has not been done and the pre-1973 water rights have not been looked at. Historical use data must be considered as well as the operational efficiency of Avista. The impact of rain fall and snow pack in the Clark Fork River basin dwarfs impacts by water users."*

Representative Jackson' assessment that Avista's water rights appear to be "crafted" is a very accurate observation. His assessment that Avista's claimed volume of 29 million acre-feet as

being untenable is also correct. Finally, his observation that "Historical use data must be considered as well as the operational efficiency of Avista." was the basis for the following quantitative analysis.

A Summary of Avista's Existing Water Rights

According to the Clark Fork River Basin Management Plan (adopted August 16, 2004), Chapter six, page 1 (See Appendix O), Avista (formerly Washington Water Power) installed turbine generators at their Noxon Rapids dam in 1951 (two turbines), 1959 (two turbines) and 1976 (one turbine). These turbines are low-head, "Francis" type turbines of varying capacities (Avista website). Table 1 offers information on the Avista's water rights at Noxon Rapids taken from General Abstracts obtained through the Kalispell Regional Office of the DNRC. Copies of the abstracts are presented in Appendix B.

**TABLE 1**

A SUMMARY OF THE AVISTA WATER RIGHTS

| Key | WR No. | USE | PRIORITY DATE | FLOW RATE (cfs) | Vol. (ac-ft) |
|---|---|---|---|---|---|
| 1 | 76N 125799 00 | Power Generation | 2/20/1951 | 35,000 | 25,538,843 |
| 2 | 76N 211891 00 | Power Generation – Electric System Load Requirement | 2/20/1951 | None Listed | 38,400 |
| 3 | 76N 211947 00 | Power Generation – Reservoir Storage for Hydraulic Head | 2/20/1951 | None Listed | 267,000 |
| 4 | 76N 211890 00 | Power Generation – Flow Regulation | 2/20/1951 | None Listed | 230,700 |
| 5 | 76N 211889 00 | Power Generation | 9/1/1959 | 5,400 | 3,909,421 |
| 6 | 76N 4189 00 | Power Generation | 11/19/1974-11:38 | 15,000 | None Listed |
| 7 | | | Totals | 55,400 | 29,983,664 |

Water Right No. 1

Water Right No. 1 has a claimed use described as "Power Generation" and is generally accepted to cover the two 1951 turbine generators. The claim is for a flow rate of 35,000 cfs and an annual volume of 25,538,853 ac-ft (See "General Abstract for WR No. 76N 125799-00). It is assumed that the claimed flow rate of 35,000 is a *combined* flow rate for both turbines (17,500 cfs each).

Suspicious aspects of WR No. 1: Comparing the claimed flow rate to the claimed volume shows that the volume was computed by extrapolating the proposed flow rate over the course of one year: (35,000 cfs)(60 sec/min)(60 min/hr)(24 hr/day)365 day/yr)/43,560 cf/ac-ft = 25,338,843 ac-ft, actually some 200,000 ac-ft shy of the accepted volume reported in the General Abstract. This volume, if viable, would indicate that the turbines are utilized continuously, 24 hours a day, 365 days per year to generate electricity. This will be shown below to be untrue.

Water Right No. 2

Water Right No. 2, also dated February 20, 1951 is for a claimed use of "Power Generation – Electric System Load Requirement". It carries no claimed flow rate, but has a claimed volume of 38,400 ac-ft.

Suspicious aspects of WR No. 2: The "General Abstract for WR 76N 211891-00" obtained from the DNRC offers no explanation as to what physical characteristic of Power Generation the terminology "Electric System Load Requirement" refer. According to the "Glossary Of Energy Terms on the Duke Energy web site (http://www.duke-energy.com/glossary-of-energy-terms/l.asp) "Load" is defined as:

> The amount of electric power delivered or required at any specific point or points on a system. The requirement originates at the energy-consuming equipment of the consumers. The load of an electric utility system is affected by many factors and changes on a daily, seasonal and annual basis, typically following a pattern. *Electric System load is usually measured in megawatts (MW).* (Emphasis mine.)

"Electric System Load", as defined above is an extremely variable quantity, subject to the varying electrical demands of a utility's customers at the various locations within the electrical system. Why Avista needs 38,400 ac-ft for "Electric System Load" is a mystery that will probably remain until such time as this water right is examined during the adjudication of the Basin.

Water Right No. 3

Water Right No. 3, also dated February 20, 1951, has a claimed use of "Power Generation – Reservoir Storage for Hydraulic Head". It has no claimed flow rate with an annual volume of 267,000 ac-ft.

Suspicious aspects of WR No. 3: In its licensing applications with the FERC, Avista provided several drawings of Noxon Rapids Dam. Included in Appendix F of this report is one such drawing: Avista Corporation's *"Exhibit F, Project No. 2058, Clark Fork Project, Noxon Rapids HED, Powerhouse and Intake Dam Cross Section"*, dated August 23, 2006. According to this drawing, Noxon Rapids Dam has a maximum high water elevation of 2331.0' and a minimum high water elevation of 2321', a difference of 10 vertical feet. According to data provided in the "Dam Directory", which is available on-line at Stanford University's web site[1], Noxon Reservoir has a surface area of 7940 acres. Consequently, the claimed hydraulic head storage of 267,000 ac-ft has a vertical component of 33.63' (267,000 ac-ft/7940 ac). No rational explanation is evident for the difference between the designed 10' water surface elevation variability due to operation of the spillway gates and the calculated 33.63' vertical component of the claimed storage.

[1] See http://npdp.stanford.edu/DamDirectory/DamDetail.jsp?npdp_id=MT00223)

Water Right No. 4

Water Right No. 4, also dated February 20, 1951 has a claimed use of "Power Generation – Flow Regulation". It has no claimed flow rate with an annual volume of 230,000 ac-ft.

Suspicious aspects of WR No. 4: One would suspect that the operation of Noxon Dam for the purpose of "Flow Regulation" related to "Power Generation" would have some component of flow associated with it. Assuming that the "Flow Regulation" is performed continuously over the course of an entire year, the associated flow rate would calculate out to 317.69 cfs (230,000 ac-ft)(43,560 sf/ac)/(365 day/yr)/(24 hr/day)/(60 min/hr)/(60 sec/min). This relatively small flow rate simply doesn't make any sense.

Water Right No. 5

Water Right No. 5 has a claimed use of "Power Generation" and carries a priority date of September 1, 1959. It is assumed to cover the two turbine generators installed in the powerhouse during that time frame. This water right carries a claimed flow rate of 5,400 cfs and an annual volume of 3,909,421 ac-ft.

Suspicious aspects of WR No. 5: If one is consistent and assumes that the claimed flow rate of 5,400 cfs for the two newer Francis Turbine Generators represents a *combined* flow rate for the turbines, as was done in the case of WR No. 1, then each of the newer turbines operates at a flow rate of 2,700 cfs. This flow rate is significantly less than the claimed flow rate for the similar turbines covered under WR No. 1 (approximately 15% of the former). As was the case with WR No. 1 the claimed volume under this water right (3,909,421 ac-ft) is exactly what one would arrive

at if you extrapolated 5,400 cfs over the course of a year: (5400)(60)(60)(24)(365)/43560 = 3,909,241 ac-ft. This infers that these turbines are run continuously, 24 hours a day, 365 days a year generating electricity. This will be shown below to be untrue.

Water Right No. 6

Water Right No. 6 has a claimed use of "Power Generation" and carries a priority date of November 19, 1974. It is assumed to cover the fifth Francis Turbine Generator installed in the powerhouse during that time frame. It carries a claimed flow rate of 15,000 cfs but has no volume associated with it. See *"General Abstract for Water Right Number 76N 4189-00"*, Appendix B.

Suspicious aspects of WR No. 6: Table 2 below presents data for the five Francis Turbine Generators at Noxon Rapids Dam. This information was obtained from the aforementioned *"Exhibit F, Project No. 2058, Clark Fork Project, Noxon Rapids HED, Powerhouse and Intake Dam Cross Section"* drawing presented in Appendix F. You can see that the four older turbines have a rotational rate of 100 rpm, while the newest turbine spins at a slightly increased rate of nearly 106 rpm. It is puzzling to the author why the oldest pair of the five turbines (covered in WR No. 1) would operate at a flow rate of 17,500 cfs per turbine while spinning at a rate of 100 rpm, the newer pair of the five turbines (covered in WR No. 5) would operate at a flow rate of 2,700 cfs per turbine, again spinning at a rate of 100 rpm, while the newest single turbine would operate at flow rate of 15,000 cfs, with a rotational rate of 106 rpm.

**TABLE 2**

NOXON RAPIDS TURBINE GENERATOR INFORMATION

| Turbine ID | Assoc. WR (Table 1 Key No.) | Turbine Capacity | RPM | NET HEAD (ft.) | Generator Capacity (kVA) | Power Factor | Generator Capacity (kW) |
|---|---|---|---|---|---|---|---|
| Unit 1 | 1 | 98,100 | 100 | 152 | 108,000 | 0.85 | 91,800 |
| Unit 2 | 1 | 98,100 | 100 | 152 | 96,000 | 0.80 | 76,800 |
| Unit 3 | 5 | 98,100 | 100 | 152 | 110,000 | 0.90 | 99,000 |
| Unit 4 | 5 | 98,100 | 100 | 152 | 110,000 | 0.90 | 99,000 |
| Unit 5 | 6 | 125,600 | 105.9 | 152 | 120,000 | 0.95 | 114,000 |

A Quantitative Approach to Estimating the Flow Rates and Volumes for the Avista Water Rights

As a water right consultant for the past 15 years, who has quantified many different types of water right uses for my clients' permit applications, I had only quantified one small private hydroelectric plant – nothing on the scale of the facilities at Noxon Rapids dam. Nevertheless, I was "up to the challenge" of attempting to accurately quantify these water rights. In this attempt to quantify Avista' existing water right uses, I took the approach that I would have had I been retained by Avista to assist them in securing their water rights today – computing the maximum justifiable quantities for their flow rates and volumes. The methodology and results of this process are as follows:

The Power Equation

Water flowing from a higher elevation to a lower elevation represents a hydraulic power potential. This potential is commonly captured through its conversion to mechanical power through the use of turbines and generators. The amount of power generated during this mechanical conversion can be calculated through what is known as "The Power Equation":

$$P = QH\eta c \qquad \text{Equation 1.0 (See Appendix P)}$$

Where:
P = Power (kW)
Q = Flow Rate (cfs)
H = Net Head (ft)
η = System (Turbine/Generator) Efficiency
c = Constant based on the density of water and the acceleration due to gravity (unitless)

In the case of the Avista water rights, the quantity P for the generators is a known value – each generator has a "nameplate" kW rating. What is unknown and what needs to be calculated is the amount of flow required to generate the nameplate power rating. Modifying Equation 1.0 to solve for Q, we get:

$$Q = \frac{P}{H\eta c} \qquad \text{Equation 1.1}$$

In the case of the Avista turbine generators, H = 152', η is estimated at 95% (0.95) and the constant "c" = 0.085.

The value of "P" is presented in Column 2 in Table 3 below, which lists the rated capacity of each of the five Avista turbine generators. The Rated Capacity data, as well as the 152' Head value were obtained from the aforementioned *"Exhibit F, Project No. 2058, Clark Fork Project, Noxon Rapids HED, Powerhouse and Intake Dam Cross Section"* drawing presented in Appendix F of this report. Using Equation 1.1, a required flow rate for each turbine generator can be calculated:

TABLE 3

CALCULATED FLOW RATES FOR NOXON RAPID TURBINE GENERATORS

| Col. 1 | Col. 2 | Col. 3 | Col. 4 | Col. 5 |
|---|---|---|---|---|
| Unit No. | Rated Capacity (kW) | As a Percentage of Total | Req'd Flow at Rated Capacity (cfs) (From Eq. 1.1) | Converted Flow Rate (ac-ft/hr) (Col. 3 x 0.0825) |
| 1 | 91,800 | 0.191 | 7,479 | 618.12 |
| 2 | 76,800 | 0.160 | 6,257 | 517.12 |
| 3 | 99,000 | 0.206 | 8,066 | 666.60 |
| 4 | 99,000 | 0.206 | 8,066 | 666.60 |
| 5 | 114,000 | 0.237 | 9,288 | 767.60 |
| Total | (See Note) 480,600 | 1.000 | 39,156 | 3,236.03 |

Note to "Rated Capacity" quantities reported in Table 3, Column 2, above: Many of the documents examined during the author's research, including the FERC license for Noxon Rapids Dam, lists the total rated capacity of the five turbine generators at 466 mW. This value is somewhat less than the 480.6 mW total capacity computed above.

As shown in Colum 4 of Table 3, the maximum flow rate required with all five turbine generators operating simultaneously at maximum rated capacity is 39,156 cfs. This value is significantly less

than the combined flow rate claimed in Avista's water rights of 55,400 cfs. Column 5 of Table 3 simply takes the calculated flow rate (in cfs) from Column 4 and coverts it to units (ac-ft/hr) that will be useable in Tables 5 through 9.

Table 4 presents a compilation of 17 years of annual hydroelectric generation data for Avista's facilities:

Avista Corporation owns and operates eight hydroelectric generation facilities. Five are located in Washington sate, two in Idaho and one, Noxon Rapids, in Montana.

Column 2 represents generation (in thousands of Megawatt-hours) for all eight of Avista's hydroelectric generating facilities. This raw data was obtained from filings Avista has made over the years with the Securities and Exchange Commission (SEC). See Appendix M.

Column 3 presents the portion of each year's total hydroelectric generation attributable to the Noxon Rapids facility as reported in Column 2. As explained in the footnote for Table 4, data for the years 2002 through 2007 is actual, while the values for the prior years were estimated based on the average of the six years of actual reported data.

In Columns 6 – 10, the annual Noxon Rapids generation figures reported in Column 3 are further broken down by turbine generator unit using the Capacity Percentage Factor from Column 3, Table 3.